L

Gypsy Moth Manual

Appendix L

Calibrating Aircraft

Contents

Introduction

Calibration is adjusting spray equipment to apply pesticide uniformly at the desired rate per acre. Calibrate each aircraft at the beginning of the program and monitor calibration during the program to assure that the discharge rate is correct and remains constant.

With hydraulic/electric driven systems, you can calibrate on the ground. For wind driven systems, the aircraft will have to fly and spray for a given amount of time.

Calibration Procedures

Use the following instructions for calibrating.

Step 1—Check for Cleanliness

Check the following aircraft parts for cleanliness before starting the calibration; check mixing equipment at this time:

- In–line and nozzle screens
- Hoppers
- Spray system and the aircraft in general

Step 2—Check for Leaks

Check nozzles for the following:

- Proper number present and all the same size
- Oriented to the desired direction
- Tips are all aligned

Load aircraft with a suitable amount (50-75 gallons) of water, run system, and check for leaks. Check for leaks with the mixing equipment (agitators) running. Check to make sure the system can maintain the desired pressure. If leaks are present, have the contractor make repairs and then recheck the equipment.

Step 3—Determine Acres Covered Per Minute

Use **Table L-1** and **Table L-2** to determine the swath width of aircraft being used on the project. For aircraft not listed, contact APHIS Aircraft and Equipment Operations for an effective swath. Use **Table L-3** to determine acres covered per minute.

For all aircraft on APHIS programs, the Department has established an effective swath width and suggested spray tip size for most fixed wing and rotary aircraft in the agricultural industry.

Aircraft categories have been established to help program planning for desired aircraft based on the insect life cycle, timing of applications, support personnel, adequate airport space, required aircraft performance, length and strength of runways, taxiways, ramps, and the elevation and type of terrain to be treated.

Electronic guidance systems have limited accuracy for identifying flight lines to correspond with the assigned swath width.

EXAMPLE: Del Norte and Motorola System standards are within 10 feet. The Loran “C” System standard is calculated in increments of 60 feet.

The swath width may be adjusted to match the electronic guidance system flight lines provided the change is *within 10 percent* of the assigned swath width.

For formation flying, only the lead aircraft needs a guidance system.

TABLE L-1: Swath Width for Airplanes

Airplane and Category[1]	Oil Mixtures[2]	Water Mixtures		Nozzle Tip[3]	
	Feet	Feet	8 oz/A Malathion	20 oz/A Sevin 4-oil	32 oz/A Orthene
Boeing B-17 (A)	500	350	8010	8015	8020
Douglas DC-4/DC-6 (A)	550	400	8010	8015	8020
Fairchild C-119 (A)	500	350	8010	8015	8020
Douglas DC-7B & 7C (A)	650	500	8015	8020	8030
L100-30 Hercules (A) (with Adds Pack Spraying System)	800	650	8008	8010	8015
Curtiss C-46 (B)	500	350	8010	8015	8020
Douglas DC-3/C47 (B)	400	300	8008	8010	8015
Lockheed PV-2 (B)	400	300	8010	8015	8020
Martin 404 (B)	500	350	8010	8015	8020
Douglas B-26 (B)	400	300	8010	8015	8020
Grumman TBM (C)	250	200	8008	8010	8015
Turbine Thrush (C)	150	100	8004	8006	8008
Turbine Air Tractor (C)	150	100	8004	8006	8008
Turbine Ag-Cat (C)	150	100	8004	8006	8008
Thrush (800hp) (C)	150	100	8003	8004	8006
Thrush (1200hp) (C)	150	100	8004	8006	8008
Ag-Cat (800hp) (C)	150	100	8003	8004	8006
Ag-Cat (1200hp) (C)	150	100	8004	8006	8008
Twin Beech/C-45 (C)	150	100	8004	8006	8008
Piper Aztec PA-23 (500hp)(C)	150	100	8004	8006	8008
Cessna (all 188 Models) (D)	100	75	8002	8003	8004
Thrush/Snow/Air Tractor (D)	125	100	8002	8003	8004
Ag-Cat (A Models) (D)	100	75	8002	8003	8004
Ag-Cat (B & C Models) (D)	125	100	8002	8003	8004
Piper Brave (D)	100	75	8002	8003	8004
Piper Pawnee (230-260hp)(D)	100	75	8002	8003	8004
Stearman (450-600 hp) (D)	100	75	8002	8003	8004
Weatherly (D)	100	75	8002	8003	8004

1 Category is shown in parentheses

2 Includes malathion and Sevin 4-Oil

3 Stainless steel flat fan

TABLE L-2: Swath Width For Helicopters

Helicopters and Category[1]	Malathion, Sevin 4–Oil, and all oil mixtures (ft)	All water mixtures (ft.)
Bell 204/205/212/214 (A)	150	120
Sikorsky S-58-T (A)	150	120
Sikorsky S-55-T (B)	120	100
Alouette III (B)	120	100
Alouette II (C)	100	75
Bell 206 (C)	100	75
Hughes 500 (C)	100	75
Hiller Seloy (C)	100	75
Bell Seloy (C)	100	75
Bell 47 (D)	100	75
Hiller 12E (D)	100	75

1 Category is shown in parentheses.

TABLE L-3: Acres Covered Per Minute

Ground Speed (mph)	Swath Width							
	30	35	40	45	50	75	100	150
40	2.4	2.8	3.2	3.6	4.0	6.1	8.1	16.1
50	3.0	3.5	4.0	4.6	5.0	7.6	10.1	20.2
60	3.6	4.2	4.8	5.4	6.1	9.1	12.1	24.2
70	4.2	5.0	5.7	6.4	7.1	10.6	14.1	28.3
80	4.8	5.7	6.4	7.1	8.1	12.1	16.2	32.3
90	5.4	6.4	7.3	8.2	6.1	13.6	18.2	36.4
100	6.1	7.1	8.1	9.1	10.1	15.2	20.2	40.4
110	66.7	7.8	8.9	10.0	11.1	16.7	22.2	44.4
120	7.3	8.5	9.7	10.9	12.1	18.2	24.2	48.5
130	7.9	9.2	10.5	11.8	13.1	19.7	26.3	52.5
140	8.5	19.9	11.3	12.7	14.1	21.2	28.3	56.6

Formula for Acres Covered per Minute

You can also determine acres covered per minute by using the following formula:

$$\text{Acres per minute} = \frac{\text{swath width (ft)} \times \text{ground speed (mph)}}{495}$$

Example:

Using a swath width of 50 feet and a ground speed of 100 mph, calculate the following:

$$\text{Acres per minute} = \frac{50 \times 100}{495} = 10.1$$

Step 4—Determine the Gallons Per Minute (GPM) Output

Use the following formula for determining gallons per minute:

$$\text{GPM} = \frac{\text{Acres per minute} \times \text{rate per acre in ounces}}{128 \text{ ounces}}$$

Example

The aircraft will cover 10.1 acres per minute. The pesticide label specifies an application rate of 60 ounces per acre. Using the figures above, the formula results in the following:

$$\frac{10.1 \text{ acres/minute} \times 60 \text{ ounces/acre}}{128 \text{ ounces}} = 4.7 \text{ gallons per minute}$$

Be sure the pump will deliver the required gallons per minute rate.

Step 5—Determine Number of Nozzles to Install (flat fans)

Use the following formula to determine the number of nozzles to install:

EXAMPLE:

$$\frac{\text{GPM}}{\text{Nozzle flow rate}} = \text{number of nozzles required for water at 40 psi}$$

To determine the number of nozzles required to deliver 4.7 GPM using a nozzle tip 8002, do the following calculations:

$$\frac{\text{4.7 GPM}}{\text{0.2 nozzle flow rate}} = \text{23.5 nozzles required for water at 40 psi}$$
round up to 24 nozzles

Use correction flow factor for materials other than water.

Step 6—Determine Flow Per Nozzle or Atomizer Per Minute

Use the following formula for determining flow per nozzle or atomizer:

$$\text{Flow/Atomizer/Minute} = \frac{\text{GPM}}{\text{number of atomizers}}$$

Example:

If the speed is 110 mph and assigned swath is 200 feet, what is the calibrated flow rate through each rotary atomizer if 6-Micronair AU5000 units are used and the applied volume is 64 oz/acre?

Answer: Acres per minute:

Using the table, you determine 44.4 acres per minute coverage.

Gallons per minute: $\frac{44.4 \text{ ac/min} \times 64 \text{ oz./ac}}{128} = 22.2$ gallons per min.

Gallons/Minute/Atomizer $\frac{22.2 \text{ GPM}}{6 \text{ atomizers}} = 3.7$ gals./min/atomizer

Step 7—Determine Pressure and Flow Settings

The flow rate of a spray tip orifice is proportional to the square root of the operating pressure. To double the flow rate, the pressure must be increased four times. The optimum pressure of 40 PSI may be adjusted slightly to achieve the exact flow rate per minute if the examples above were used initially to set up the aircraft. In some instances, removing or adding a nozzle may be required. When using rotary atomizers, refer to the manufacturer flow chart to determine the most accurate combination of pressure and variable restrictor unit (VRU) setting.

Step 8—Test Output of Spray System

For Hydraulic/Electric Driven Systems: Load the aircraft with a suitable amount of spray formulation (50-75 gallons). Prime the system and set the pressure.

Evacuate air from boom ends by either: 1) opening end caps slightly, 2) installing valves in boom tips; or (3) connecting outboard atomizer inlet to outermost boom port. See **Figure L-1** for diagram.

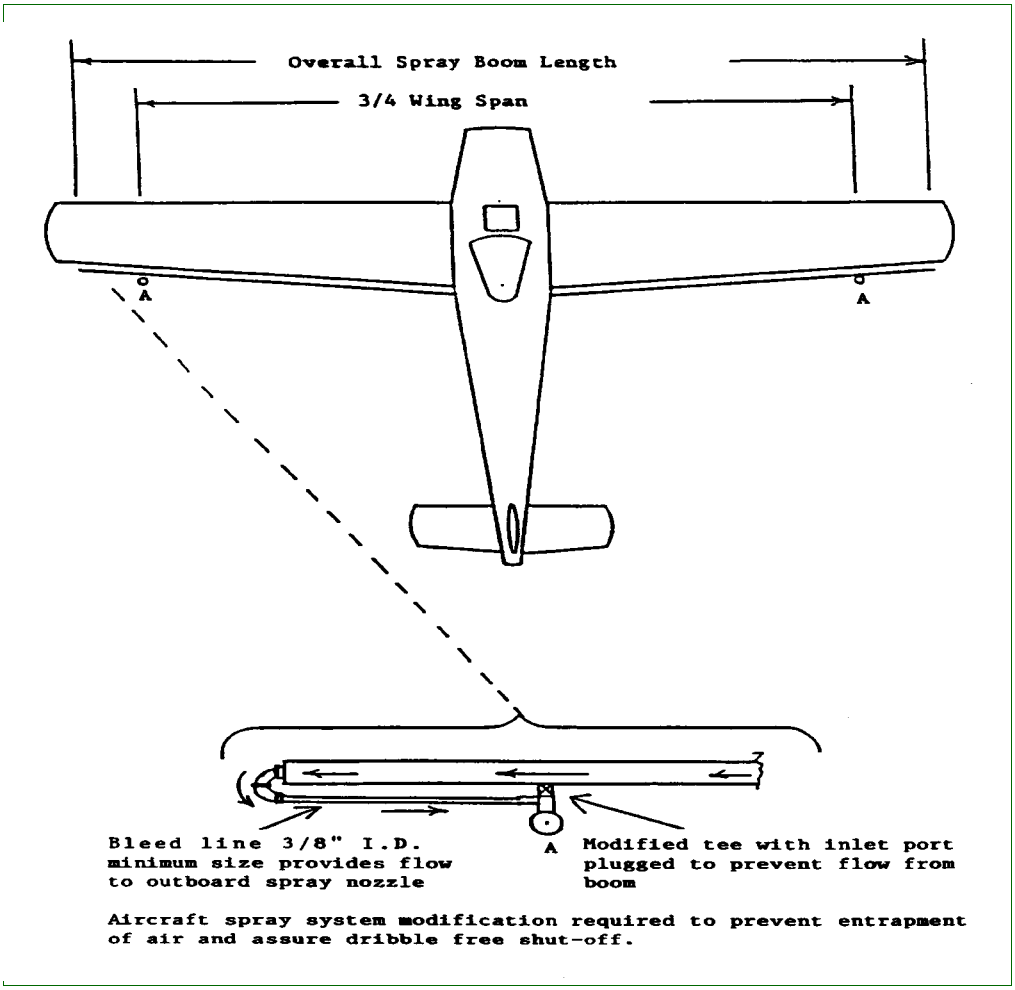

FIGURE L-1: Diagram of spray boom flow through bleed line to outer nozzles

Place a bucket under each atomizer/nozzle and run the spray system for 1 minute.

Collect material from each nozzle, measure volume output from each atomizer/nozzle, and compare to calculated rate. Check total output. If the amount is low, then raise the pressure for small amounts or add nozzles for greater amounts needed. If the amount is high, then lower pressure or remove nozzles. The VRU setting can be adjusted when using Micronair atomizers if pressure changes are not suitable.

Optimally, the system should deliver the desired amount of spray. Plus or minus 5 percent is acceptable.

For Wind Driven Pumps: Load the aircraft with a suitable amount of spray formulation (50-75 gallons). Fly the aircraft to prime the system. Set the pressure while in flight. This must be accomplished in a designated area or in the treatment area. After the system is primed, position the aircraft on a level surface and mark the location of the

aircraft tires on the loading area. Add a measured volume of product to the spray tank and note the level either through a sight window or by measuring the distance from the top or bottom of the tank to the fluid surface of the product.

Fly the aircraft and operate the spray system for 1 minute over the designated area or treatment area.

Return the aircraft to the same location as marked and measure the amount needed to refill to the original level. Use this amount to calculate the output per minute.

Adjust the spray system, if necessary, to change output. If the amount is low, then raise the pressure for small amounts or add atomizers/nozzles for greater amounts needed. If the amount is high, then lower pressure or remove atomizers/nozzles. The VRU setting can be adjusted when using Micronair atomizers if pressure changes are not suitable.

Optimally, the system should deliver exactly the desired amount of spray; however, plus or minus 5 percent is acceptable.

With some material, the viscosity and flow rate will change with temperature changes which can result in inaccurate application.